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XRD and Diamond PCD Detector Characterization

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Beamline(s): U3C/X8A

Introduction: Los Alamos operates a number of satellite systems that monitor x-ray, gamma ray and particle fluxes in space. The detectors for these systems need to be stable, rad hard and with known response characteristics. Beamlines U3C and X8A are optimized for characterization and calibration of detectors, filters, mirrors, etc, and are being used to test and characterize some of the prototype detectors for the space-based systems.

Methods and Materials: Approximately 50 carbon cathode x-ray diodes (XRD) with and without filters, four aluminum XRDs and 6-diamond photoconductive diodes (PCD) were characterized. Some of the carbon cathodes had been irradiated with a variety of particle fluxes to test for damage. Their response was measured from ~ 50 eV to 5500 eV using both U3C and X8A. The measurements were made in a calibration chamber that incorporated a calibrated silicon diode reference detector.

Results: The results for the virgin (no particle radiation) carbon XRDs were generally as expected for these types of detectors. There was more variability among the detectors than expected, however. The effect of particle radiation on the response was undetectable for fluxes less than ~ 10^13 (O+, H+, He+, Fe+ …) but degradation was observed for fluxes of 10^16 and greater. Thin film filters of C, B, and Al were not affected by the particle fluxes. The aluminum cathode XRDs also showed the expected response shape but deviated from previous calibrations. This may be caused by surface contamination. The diamond PCD had several orders of magnitude grater response than the XRDs and the response followed a model calculation quite well. Field distribution within the PCD had a strong effect on the response.

Conclusions: Use of the U3C/X8A calibration facility is proving to be very useful for detector development and characterization for future space based detector systems.